A Synopsis of the Research Topic

'ASSESSMENT OF PERIPHYTIC GROWTH ON THE ACACIA SP. AND MULBERRY SP. FOR ITS APPLICATION IN CARP CULTURE'

Submitted for the registration to Ph. D. in Zoology

To

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,

PIN- 431606. M. S.

Under the Faculty of Science and Technology

At the Research Centre

Department of Zoology, School of Life Sciences,
Swami Ramanand Teerth Marathwada University, Nanded

By the Research Scholar

Miss. Tabassum Fatima Shaikh Aslam

Under the Guidance of

Dr. S. P. Chavan,
Professor and Head, Department of Zoology,
School of Life Sciences,
Swami Ramanand Teerth Marathwada University, Nanded

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INTRODUCTION

The German word “aufwuch" stands for periphyton (also termed as biofilm); that consist of organisms viz. algae, rotifers, protozoa, bacteria, along with free living microbes, similarly invertebrates and their larvae are attached to substrates like stones, rocks and sticks etc. (Andrew, 2005; Chavan et al., 2012 and Yasmeen et al., 2017). According to Azim et al. (2005) “periphyton is complex aquatic biota attached to underwater substrates has association of non-attached organisms”. Periphyton is living microflora and fauna community attached to surface of submerged objects in water (Wetzel, 1983).

The substrate surfaces are used for the fixation of periphyton community and increase food availability for fishes. Periphyton community is good source of natural and nutritional food. It provides primary productivity that supports a wide range of aquatic organisms easily grazed upon by small invertebrates, fishes and shrimps. Hence, contributes in the productivity of aquatic ecosystem, as a source of low-cost live food for fish (Chavan et al., 2012).

Practices of periphyton- based culture have been developed independently and used to catch fish in open waters in diverse parts of the world. The West Africa, this practice is known as Acadja; in Sri Lanka it is called Katha and Athkotu; in Cambodia it is called Samarahs; in Indian state like Assam it is called Xeng and in Manipur known as Phum. Periphyton- based aquaculture system is a modern concept and known as green revolution in aquaculture. Periphyton is a preferable food for Indian major craps, *Tilapia sp.* And freshwater prawns (Yasmeen et al., 2019).

The colonization process of periphyton and their growth yield production etc. depends on the substrate types, habitat and location. The substrates used by researchers were biodegradable substrates such as jowar plant stem, cotton plant stem, palm leaves, aquatic weeds, sugarcane bagasse etc. and non biodegradable substrates like plastic bottles, nylon thread, PVC pipes, etc. (Yasmeen et al., 2019). The concentration of periphytic algae and micro periphyton on studied biotic substrates are considerably higher to organisms grown on artificial substrates.

In present study agricultural waste from Acacia sp. and mulberry plant will be used as a substrate for periphyton culture. Marathwada region of India has various species of

Acacia such as *A.cambellii, A.nilotica, A.caesia, A.ferruginea,* etc. These species can be used as a substrate for periphyton growth. The mulberry plant is widely cultivated to feed the silkworms employed in the commercial production of silk. Mulberry plant is widely distributed in India. In India *Morus laevigata, M.serrata, M.alba* and *M.indica* are found. The agricultural or sericulture waste of Mulberry plant such as stem and branches can be used as substrate for periphyton growth.

The periphyton from these substrates can be used as food for carp culture. Carp culture is the oldest form of aqua culture known to the world. The cyprinidae are the family of freshwater fishes, which includes the carps and their relatives. The carp culture include the culture of Indian Major Carp (catla, rohu and marigal) and exotic carps (silver carp, grass carp and common carp).

REVIEW OF LITERATURE

Azim M.E. (2001) studied the suitability of four locally available substrates for periphyton growth and performed the periphyton based production and growth of four indigenous species, rohu Labeo rohita (Hamilton), catla Catla catla (Hamilton), Kalbaush L. calabus (Hamilton) and gonia L. gonius (Linnaeus) was evaluated under single species and polyculture conditions. It was observed that the nutritional quality of periphyton was adequate to support the dietry needs of the experimental fish.

Azim et al. (2002) found results as a first step in assessing the viability of periphyton based fish production in South Asian pond aquaculture systems, the effects of artificial substrates on development of periphyton and on water quality were evaluated. Artificial substrate prepared from poles of bamboo, kanchi or hizol tree branches. Maximum periphyton productivities of 1.01, 1.38 and 1.03 g Cm^{-1} d^{-2} were obtained from bamboo, hizol and kanchi substrates, respectively. Taxonomic composition of periphyton showed a rapid development of a relatively stable community with few differences between the substrate types. Based on a periphyton productivity estimate, periphyton alone can sustain an estimated fish production of 5000 kg/ha/year through the addition of a substrate area equivalent to 100% of the pond surface area.

Huda et al. (2002) revealed that the production practices and relative profit to the periphyton based aquaculture both on stations as well as on farm. It was reported that low production cost required by this technology and provide more yield as compare to any other techniques. This technology is economically very beneficial for fish production or

aquaculture to get better yield. In this study it was proved that periphyton based aquaculture is economically important and useful for optimum utilization of aquatic natural resources.

Khatoon et al. (2007) focused on the growth of periphyton on the different substrates is different and substrates are introduced in water for improvement of water quality. Each substrate was analysed and they observed more biomass of different periphytic algae and biofouling of organisms. Severe biofouling was observed on the substrates by polycheates after 60 days. Periphyton growth was higher on the Bamboo as compare to the PVC pipes, plastic sheet, fibrous scrubber and ceramic tiles. Periphyton biofilm can improve the water quality and provide excess nutrients in aquaculture.

Saikia et al. (2009) reported that periphyton was used as traditional rich feed in aquaculture system i.e. utilized by the fishes, prawns and crabs etc. The periphyton growth in the rice field are grazed by periphytophagus fish. In this study concluded that rice straws were suitable substrate for periphyton production in the aquatic system. In India 60 genera of microflora and fauna are periphytic in nature was reported.

Chavan et al. (2012) reported the periphyton development in freshwater habitat providing natural food for fishes and aquaculture system. Highest percentage of cladocerans, larval density, insect diversity and planktonic density was observed on the cotton substrates as compared to jawar substrates.

Gangadhar et al. (2012) studied on the biodegradable substrates in culture system that end product was the production of biofilm/periphyton which serves as an additional natural food source for cultured fish. The sugarcane bagasse was result in enhanced the water quality and growth of fishes.

Shaikh Y.A. et al. (2019) reviewed periphyton used as live food in aquaculture & periphyton classification on the basis of substrates used for growth. The periphyton growth was estimated by different researchers depending upon types of substrates, types of habitat and animal used. Different aquaculture traditional methods are used in various regions of the world. It has a role in nutrient transfer and uptake of nutrient from the lower trophic level to higher trophic level due to that it performs role in biological cleaning of water.

Shaikh Y.A. et al. (2019) studied the periphyton growth on different substrate viz. Acacia nilotica stem, mulberry stem and scales of Catla catla for the first time except substrate as stone. The substrates were inoculated in water for periphyton growth and incubated for 30 days. The water parameter showed variation in the initial and substrate added water as compared to aquaculture standards.

OBJECTIVES

The current study mainly focuses on screening of substrates for periphyton growth and physico-chemical analysis of water samples. The periphyton based Carp growth analysis. The proposed objectives for the work are as under:

1. *Ex-Situ* analysis of development and growth of periphyton on some selected substrates.
2. *Ex-Situ* culture of IMC fry and their yield production in the periphyton based systems.
3. Periphytic C/N ratio and their correlation with IMC cultural growth and production.
4. Proximate analysis of periphyton samples and their correlation with culture of IMC.
5. Correlation of biofilm and biofouling in the selected periphyton system for IMC culture.
6. Carcass analysis of IMC and its correlation with the periphytic diversity.

METHODOLOGY

1. Collection of water sample and substrates for basic culture:

The planktonic water sample will be collected from river use as a basic culture sample to develop periphyton system. The agricultural waste material of wild plant Acacia and mulberry plant will be used as substrate for periphyton growth. The variants of substrates such as length, weight, plane with bark and without bark, branches, stem, roots, dried, semidried, fresh and wet will be used.

2. Ex-situ screening of substrates for periphyton growth:

In a medium size plastic trough a layer of 1 cm soil will be put on the base of all troughs as a source of nutrient and it will be provided with manure for proper growth of periphyton. The substrates will be submerged at the base of trough with the pond water and tap water in the ration 1:9 respectively. The light will be provided for photosynthesis

in periphytic system. The experimental substrates will be kept in the trough for 30 days (Dharamraj et al. 2002).

3. Physico-chemical analysis of water:

The physico-chemical parameters of initial water and substrates added water will be analyzed by standard method of APHA (APHA 2005, Trivedy Goel, 1998). The parameters viz. Temperature, pH, Dissolved Oxygen, Chloride, Alkalinity, Free CO_2, Hardness, Calcium Hardness, Nitrate, Sulphate and Phosphate will be analyzed.

4. Analysis of periphyton:

Quantitative analysis of periphyton will be carried out using haemocytometer. The biomass of periphyton will be determined to gravimetric method (APHA, 2005). The Shannon Wiener Diversity Index, H' will be calculated on the basis of number of taxa and individual abundance of organisms present in the sample (Shannon and Wiener, 1949). The quantification of biofoulers (larvae) will be done by manual counting (Robert). Preparation of permanent slides and identification of periphyton and larvae will be carried out (APHA, 2005). The enumeration of bacteria by spread plate method in water and from substrate and also isolation of bacteria will be carried out.

5. Collection, Maintenance and Growth analysis of carp:

Fingerlings of carps will be purchased from market and will be brought to the laboratory. The fingerlings will be maintained in the aquarium of size 5ft ×2ft× 2 ft. in the laboratory. Routine cleaning and maintenance of aquarium will be done. After two weeks these carps will be cultured in outdoor cement tanks for 120 days (Mudduraj et al., 2002). All the tanks will be provided with cow dung and CaCO3 and will be filled with water. The substrates used for periphyton growth will be introduced in the tanks. Determination of fish growth will be analysed by using weight length studies (Chavan et al., 2012, Thulasitha et al., 2012 and Rai et al., 2010).

6. Statistical Analysis:

The data was analysed by applying S.D. in SPSS 16.0.

7. Carcass Analysis:

The percentage of moisture content will be determined in the different age gruop of fishes by using standard methods of AOAC. For estimation of crude protein Lowry's method (1951) will be used. Estimation of crude lipid will be carried out by Folch method.

IMPORTANCE OF STUDY:

INTERNATIONAL STATUS

Aquaculture is the fastest growing food supply sector in the world. In 2018, the world's total aquaculture production reached all time high of 114.5 million tonnes in live weight. A large part of the world's fish culture production relies on the use of freshwater ponds among which carp culture is the oldest form of aqua culture known to the world. Currently two third of fish production is carp. The development of inland aquaculture is seen as an important factor contributing to food security in different parts of the world.

The rapid growth in aquaculture has triggered new technological advancement such as '**periphyton based aquaculture'.** More over compared to harvesting of small planktonic algae from the water column, attached periphyton can be grazed more efficiently by the cultured fish. This technology has been common in tropical Africa and Asia for many years as a traditional way of enhancing fisheries in coastal lagoons without adding artificial feeds. It's application was recently expanded in Bangladesh and India, mainly in the polyculture of Indian Major Carps, where introduction of the substrates had a positive effect on consequent periphyton development, production of the target species and water quality. Periphyton has been used successfully to augment production of carp, tilapia and catfish in freshwater pond.

In recent years, extensive researches are going on traditional periphyton based aquaculture practice as fisheries enhancement technique throughout the world.

NATIONAL STATUS

India is also an important country that produces fish through aquaculture in the world. India is home to more than 10% of the global fish diversity. Presently, the country ranks second in the world in total fish production with an annual fish production of about 9.06 million metric tonnes. Fish culture in India have been playing an important role in the economy. Carps have been the backbone of aquaculture practice in india and it is the three Indian major carps viz. Catla, Rohu and Mrigal together with three other exotic carps viz. silver carp, grass carp and common carp contribute over 85% of the aquaculture production of the country.

In recent years, the concept of periphyton based aquaculture has been tested and applied with varied degrees of dependence on periphyton as food or substrates as shelter for

cultured animals (Uddin M.S., 2007). In India the fish farmers of Assam widely use traditional practice of fish culture. They install bamboo branches locally known as Xeng which provide shelter for fish and also provide food in the form of periphyton. In the state of Manipur on the North eastern part of India, substrate based aquaculture system are widely prevalent in the Lok Tak Lake. Floating islands formed through the dense growth of aquatic weeds and grasses are spread throughout the lake and are used as the natural fish aggregating devices. Saikia and Das (2009) reported the traditional periphyton based organic rice fish practice in north eastern India, locally known as ‘aji gnui assonii' where common carp (*C.carpio*) utilizes the aquatic biota as the source of natural food (Dutta. 2018).

SIGNIFICANCE OF THE STUDY

Aquaculture is not always a truly sustainable practice, so far the supply of external feeds, chemicals and energy inputs are concerned. Therefore, the trophic status of periphyton led researchers to realize it as a future potential of sustainable system hiding under the water. Horn reported that the herbivorous fish in nature feeds largely on benthic, epilithic or periphytic algae rather than on phytoplankton. Wetzel (1983) reported that the production of periphytic algae per unit surface area is higher than phytoplankton. Horn and Golderman stated that ‘it is mechanically more efficient to scrap or graze a two dimensional layer of periphyton than a filter algae from three dimensional planktonic environment.

In Marathwada India the Acacia sp. are widely distributed in all districts, deciduous forests, hill forests and cultivated in gardens. The agricultural waste of Acacia can be used for periphyton based aquaculture. Mulberry sericulture is widely practiced in India. It is an agro based industry. The agricultural waste and left over of sericulture of mulberry plant such as roots, stem and branches can be utilized as substrates for periphyton growth which has importance in aquaculture. In this way we can utilize the agro waste in aquaculture. Periphyton based aquaculture is low cost technology. It is modern concept and eco-friendly system. The development of such periphyton based aquaculture technology appears to be feasible and it can bring about major advances in the development of low cost farming in aquaculture with no additional feed and reduction of pollutants.

The present study will help in use of agriculture waste of Acacia and mulberry for periphyton growth which is natural food for fish, it reduces the need of artificial food which is mainly introduced in pond culture. During the study the production and growth of Indian major carps and exotic carps will be analysed in response to periphyton culture system. This study will be useful in carp culture technology. Due to the low cost this technology can be applied by many fishermans throughout the world. This technology increases economy and decreases the external cost required during carp culture.

WORK PLAN

In the Year (2021-22 and 2022-23)

In the first year of Ph. D. mostly course work and literature review will be carried out along with collection of planktonic water sample and substrates from Marathwada region and its observation, identification and analysis for plankton diversity. The collection of water sample and substrates, physico chemical analysis of water and assessment of periphyton growth, taxonomic identification and analysis of periphyton will be carried out in first two years.

In the Third Year (2023-24)

In the third year the periphyton based carp culture will be carried out along with thesis writing, publication of research paper in conference and journals and submission of thesis.

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